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## Studies in North American Peronosporales—I. The genus *Albugo*

GUY WEST WILSON

The North American species of *Peronosporales* offer a rich field for investigation. Containing as this order does some of the worst fungous pests of the farm and garden, extensive studies of certain species were undertaken at an early date in our mycological history, yet our present knowledge of the group is very fragmentary. The greater part of the printed information concerning it consists of notes on various species scattered through articles of a general mycological nature. Some species have been made the subject of independent articles, while few papers deal with a considerable number of species. Only two of these are comprehensive in scope. One is a series of notes by Swingle \* upon the specimens in the herbarium of the Division of Vegetable Pathology, the other is Dr. Farlow's monograph,† which includes thirty-eight species and requires less than an octavo page for a complete host index. Since then the number of species credited to North America has almost doubled and the list of hosts increased many fold.

The genus *Albugo* constitutes the family *Albuginaceae*, the species of which bear a superficial resemblance to the *Uredinales*, from which they are readily distinguished by the light color and glistening appearance of the sorus and by the unsculptured conidia which are borne in chains. More marked points of difference, but not so readily observed, are the germination of all spores by zoospores instead of by germ-tubes, and the production of sexual oöspores.

The oöspores of all the North American species have been studied, in the preparation of the present paper. Upon the basis of oöspore-characters the species fall into two well-defined groups. The first of these includes the North American *A. candida*, *A. Ipomoeae-panduranae* and *A. Lepigoni*, and the foreign *A. sibirica* and *A. tropica*. This group is characterized by having the episore of the

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\* Jour. Myc. 7 : 109-130. 1892.

† Bot. Gaz. 8 : 306-325, 327-337 ; 9 : 37-40. 1883-84.

oöspore tuberculate or ridged. According to the investigations of Zalewski \* and Stevens † this is the more specialized group. The former author points out the more complex character and apparently more complete development of the epispore, while the latter deals with cytological phenomena only. The second group of species is characterized by a reticulate epispore and contains the remaining species of which the oöspores are known, and in all probability the two species in which they are at present unknown. There are three or four well-defined types of reticulation represented, all of which are found among the American species. The first of these is represented by *A. Bliti* and *A. platensis* and may be considered typical of this group. The reticulations are very evident, the meshes large and the areolae deep and unoccupied by any elevations. The pattern is often somewhat imperfectly developed. From this type the other species vary in a striking manner, yet the primary characters remain the same. In *A. Tragopogonis* and *A. Swertiae* the areolae are not so deep and the reticulations are crested at their angles with more or less prominent tubercles. In *A. Portulacae* the variation takes the form of tubercles within the areolae while the reticulations themselves are similar to those of *A. Bliti*. Unique within the genus is *A. occidentalis*, which has the epispore finely reticulate and the areolae so shallow as to give the impression, at first sight, of pits rather than reticulations. The conidia are quite similar to those of *A. tropica*, but the oöspore-characters indicate a closer relationship to *A. platensis* or *A. Swertiae*. According to Zalewski the reticulate spores have a less perfectly developed epispore which reaches its highest development in *A. Tragopogonis*. This arrangement of species is confirmed by the work of Stevens.

The material upon which the present paper is based is contained in the herbaria of the New York Botanical Garden and of Columbia University and in the private collections of Dr. L. M. Underwood, Dr. J. C. Arthur and the author. The literature of the genus has been carefully looked over by means of Dr. Farlow's Bibliographical Index and other aids. No localities are cited from which material has not been examined, but all published

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\* Bot. Cent. 15 : 215-224. 1883.

† Bot. Gaz. 32 : 77-98, 157-169, 238-261. pl. 1-4 + text figs. 1901.

reports have been taken into account in determining the distribution of species; and mention is made of all reported hosts upon which no specimens have been seen. The determinations of all hosts have been verified, with the resulting omission of a few of those previously published. These discrepancies are noted in the proper places by the insertion after the specimen of the previously published host name. All specimens containing oöspores are marked by an asterisk (\*). Inasmuch as the hosts, or species closely related to the hosts, of all the extralimital species of the genus occur in North America, these species have been included in the key, and brief mention made of them in their place in the sequence of species. In conclusion I wish to express my appreciation of the courtesies which have been shown me in this work by the loan of specimens, by critical suggestions and by the determination of hosts.

ALBUGO (Pers.) S. F. Gray, Nat. Arr. Brit. Pl.

I: 540. 1821

*Uredo* § *Albugo* Pers. Syn. Meth. Fung. 223. 1801.

*Cystopus* Lév. Ann. Sci. Nat. III. 8: 371. 1847.

Conidiophores simple, cylindric or clavate, crowded into sub-epidermal sori without peridium or paraphyses; conidia cylindric or globular, borne in chains, smooth, hyaline or with light-yellow contents; oöspores globular, produced in various parts of the host, often separate from the conidia and forming more or less conspicuous masses; spores liberated by the rupture of the epidermis of the host; germination always by zoöspores.

Type species, *A. Cruciferarum* S. F. Gray = *Uredo candida* Pers.

#### Key to the species

Oöspore tuberculate; conidia globose or more or less cylindric, not as long as broad, if discoid the membrane of equal thickness throughout.

Oöspore with prominent tubercles; conidia similar, or the terminal smaller.

Oöspore with a few very large tubercles; conidial membrane of equal thickness throughout.

Conidia globular, hyaline.

Conidia and oöspores large; hosts

Papaverales, mainly Brassicaceae. 1. *A. candida*.

Conidia and oöspores small; hosts

Boraginaceae.

2. *A. sibirica*.

Conidia discoid, yellow.

3. *A. tropica*.

- Oöspore with numerous small tubercles; conidial membrane with an equatorial thickening. 4. *A. Ipomoeae-panduranae*.
- Oöspore finely echinulate; conidia dissimilar, the terminal larger. 5. *A. Lepigoni*.
- Oöspore reticulate (unknown in nos. 8 and 9); conidia cylindric or elliptic, usually longer than broad, if discoid the membrane with an equatorial thickening.
- Oöspore with the areolae unoccupied; conidial membrane with an equatorial thickening.
- Oöspore coarsely reticulate; conidia elongate.
- Oöspore with the reticulations tuberculate at their angles; conidia cylindric, or with more or less rounded corners, hyaline, the terminal larger.
- Conidial membrane always with an equatorial thickening.
- Conidia more or less rounded; hosts Gentianaceae. 6. *A. Swertiae*.
- Conidia cylindric; hosts Compositae. 7. *A. Tragopogonis*.
- Conidial membrane of the terminal conidium only with an equatorial thickening. 8. *A. quadrata*.
- Oöspore without tubercles; conidia obovoid or elliptic.
- Conidia obovoid, the terminal larger. 9. *A. Tillaeae*.
- Conidia elliptic, the terminal smaller.
- Conidia uniformly hyaline. 10. *A. Bliti*.
- Conidia light-yellow, the terminal with a dark equatorial band. 11. *A. platensis*.
- Oöspore finely and shallowly reticulate, appearing pitted; conidia discoid, yellow. 12. *A. occidentalis*.
- Oöspore with a tubercle in each areola; conidia cylindric, the membrane of uniform thickness. 13. *A. Portulacae*.

# I. ALBUGO CANDIDA (Pers.) Kuntze, Rev. Gen. Pl.

2: 658. 1891

*Aecidium candidum* Pers. in Gmelin, Syst. Nat. 2<sup>2</sup>: 1473. 1791.

*Uredo candida* Pers. Syn. Meth. Fung. 223. 1801.

*Uredo Cheiranthi* Pers. Syn. Meth. Fung. 224. 1801.

*Cystopus candidus* Lév.; Berk. Jour. Hort. Soc. London 3: 271. 1848.

Sori on all parts of the host except the roots, white or rarely light-yellow, prominent and rather deep-seated in the tissues of the host, very variable in size and shape, often confluent and frequently producing marked distortion of the host; conidiophores hyaline, clavate, about  $35-40 \times 15-17 \mu$ ; conidia similar, globular, hyaline, with uniform thin walls,  $15-18 \mu$ ; oöspores usually confined to the stems and fruits of the host, rarely in the leaves, chocolate-colored,

about 40–55  $\mu$ ; epispore thick, verrucose, or with low blunt ridges which are often confluent and irregularly branched.

This is the most widely distributed and by far the commonest species of the genus. Occurring as it does upon such a large number of hosts, a wide variation in characters is to be expected, yet an examination of numerous specimens, both American and foreign, has shown a remarkable stability of essential characters. The fungus as it grows upon *Bursa*, from which it was originally described, does not differ materially, either in habit or measurements, from that upon other species of *Brassicaceae*. In Europe the same fungus attacks various species of *Capparidaceae* and exhibits the same characters. An *Albugo* which occurs in Europe upon *Reseda* has also been referred to this species, from which it differs materially in habit, producing a much thinner and more superficial sorus than those produced upon the other two families of hosts. In the absence of oöspores and of perceptible difference in the conidia this disposition of the material had best be retained. The point of greatest variation in the species in America is that of oöspore-formation. The oöspores have not been observed on the majority of hosts and their location varies greatly in cases where they are known. Oöspores have been examined from the following hosts: *Brassica nigra* (stems), *Bursa Bursa-pastoris* (capsules), *Camelina microcarpa* (leaves), *Raphanus sativus* (capsules), *Roripa Armoracia* (leaves) and *Sophia pinnata* (leaves). Swingle\* also reports oöspores from *Dentaria diphylla* (leaves), *Bursa Bursa-pastoris* (stems) and *Lepidium campestre* (stems). The morphology of this species has been studied by Wager† and Stevens.‡

#### ON BRASSICACEAE:

*Arabis furcata* S. Wats., Montana, Rydberg & Bessey 4230; Washington, Suksdorf 266.

*Arabis lyrata* L., New York, Underwood.

*Arabis virginica* (L.) Trel., Alabama, Underwood; Mississippi, Tracy.

*Barbarea Barbarea* (L.) MacM., California, Heller 5108 (Fungi Columb. 1710).

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\* Jour. Myc. 7: 110, 111. 1892.

† Ann. Bot. 10: 297–342. pl. 15, 16. 1896.

‡ Bot. Gaz. 32: 91, 98, 254. pl. 2. 1901.

- Brassica arvensis* (L.) B. S. P., South Dakota, *Chaney*.  
*Brassica campestris* L., Massachusetts, *Humphrey* (Econ. Fungi 401).  
*Brassica integrifolia* (West.) O. E. Schultz, St. Croix, *Rick-secker* 336.  
*Brassica nigra* (L.) Koch, Alabama, *Carver*; Illinois, *Burrill*; Indiana, *Olive*; Iowa, *Arthur*; Nebraska, *Williams*; New Jersey, \* *Halsted* (Econ. Fungi 256); South Dakota, *Griffiths* (W. Am. Fungi 46).  
*Brassica* sp., Wisconsin, *Pammel*.  
*Bursa Bursa-pastoris* (L.) Britton, California, *Copeland*; Illinois, *Earle*, *Seymour*; Indiana, *Underwood* 3734 (Ind. Fl. 98a), \* *Wilson*; Iowa, *Macbride*; Kansas, *Baker* (Fungi Columb. 2108); Massachusetts, *Farlow* (N. Am. Fungi 204a); Michigan, *Beal* (Econ. Fungi 257b); Missouri, *Galloway*, *Galloway & Tracy*, *Trelease*; New Jersey, *Halsted* (Econ. Fungi 257a), *Stevens*; New York, *Arthur*, *Britton*, *Underwood*, *Underwood & Cook* (Illust. Fungi 91); Ohio, *Kellerman* (Ohio Fungi 122); Ontario, *Dearness* (Fungi Columb. 133); Wisconsin, *Pammel*.  
*Camelina microcarpa* Andr., Ohio, \* *Tyler* (Ohio Fungi 63, on "*C. sativa* (L.) Crantz"); Virginia, *Murrill*.  
*Cardamine bulbosa* (Schreb.) B. S. P., Indiana, *Olive*.  
*Cheiranthus asper* Nutt., Oregon, *Suksdorf* 220.  
*Cheiranthus pacificum* Sheldon, Oregon, *Sheldon*.  
*Dentaria diphylla* Michx., New York, *Shear* (N. Y. Fungi 199), *Underwood*.  
*Dentaria laciniata* Muhl., South Carolina, *Rolfs* 1687.  
*Hesperis matronalis* L., Ontario, *Dearness*.  
*Iodanthus pinnatifidus* (Michx.) Steud., Indiana, *Arthur*.  
*Lepidium densiflorum* Schrad., Nevada, *Baker* 1087.  
*Lepidium virginicum* L., Florida, *Hume* 34; Illinois, *Earle*; Indiana, *Arthur*, *Underwood*; Kansas, *Bartholomew* (Fungi Columb. 2110); Nebraska, *Williams*; New York, *Underwood*; Mississippi, *Tracy*; South Carolina, *Ravenel* (Fungi Car. 4: 93), *Rolfs* 1661; Texas, *Ravenel* 291a; Bahama Is., *Hitchcock* (on "*Cakile maritima* Scop.?"); Bermuda, *Brown & Britton*.

- Neslia paniculata* Desv., Quebec, *Eggleston* 2978.
- Raphanus sativus* L., Illinois, *Breyfogle*; Indiana, *Underwood*; Iowa, *Arthur*; Kansas, \**Bartholomew* (Fungi Columb. 1805); New York, *Arthur*, \**Underwood*.
- Roripa Armoracia* (L.) A. S. Hitchcock, Indiana, *Stewart*, \**Wilson*; Kansas, *Bartholomew* (Fungi Columb. 1806), *Kellerman*; Massachusetts, *Seymour* (Econ. Fungi 454b); Missouri, *Demetrio* (N. Am. Fungi 2420); New Jersey, *Stevens*; New York, *Arthur*, *Holzworth*, *Underwood*; Ohio, *Kelsey* (Econ. Fungi 454a); South Dakota, *Williams*.
- Roripa hispida* (Desv.) Britton, Illinois, *Arthur*.
- Roripa obtusa* (Nutt.) Britton, Kansas, *Bartholomew* (Fungi Columb. 2109).
- Roripa palustris* (DC.) Bessey, Oregon, *Cusick* 2600.
- Roripa sessiliflora* (Nutt.) A. S. Hitchcock, Illinois, *Patterson*; Iowa, *Ehinger*; Kansas, *Bartholomew* (Fungi Columb. 2001); Kentucky, *Price*; Tennessee, *Ruth* 747.
- Roripa Walteri* (Ell.) Greene, Florida, *Underwood*; Texas, *Bush* 25, *Lighthipe*.
- Schoenocrambe linifolium* (Nutt.) Greene, British Columbia, ? *Macoun*.
- Sisymbrium officinale* (L.) Scop., Indiana, *Arthur*, *Olive*, *Underwood*, *Wilson*; Massachusetts, *Farlow* (N. Am. Fungi 204b); Missouri, *Bartholomew* (Fungi Columb. 2111); New Jersey, *Halsted* (Ec. Fungi 259a); New York, *Underwood* 270a; Nova Scotia, *Robinson* 463a; Ontario, *Dearness* (Econ. Fungi 259b); Pennsylvania, *Britton*; Washington, *Parker*, *Piper*; Wisconsin, *Pammel*.
- Sophia Hartwegiana* (Tourn.) Greene, Montana, *Anderson*, *Kelsey*.
- Sophia incisa* (Engelm.) Greene, Colorado, *Baker*, *Earle* & *Tracy* 1084; Montana, *Kelsey*.
- Sophia millefolia* Rydb., Indiana, *Underwood*.
- Sophia pinnata* (Walt.) Britton, Arizona, \**Griffiths* (W. Am. Fungi 335); Indiana, *Underwood* (Ind. Fl. 98b); Durango, *Palmer*.
- Thlaspi glaucum* A. Nelson, Wyoming, *Nelson* 4177.
- Thlaspi Nuttallii* Rydb., Montana, *Blankinship*.



*Brassicaceae* sp., Montana, *Anderson*.

The following additional hosts are reported within our limits : *Arabis glabra* (L.) Bernh., *Brassica Napus* L., *B. oleracea* L., *Cakile edentula* (Bigel.) Hook., *Cheiranthus* sp. cult., *Coronopus* sp., *Draba caroliniana* Walt., *Lepidium campestre* (L.) R. Br., *L. sativum* L., *Roripa Nasturtium* (L.) A. S. Hitchcock, and *Sinapis alba* L.

TYPE LOCALITY : Europe, on *Thlaspi Bursa-pastoris* L. = *Bursa Bursa-pastoris* (L.) Britton.

DISTRIBUTION : Southern Canada to Mexico, Bermuda, and the West Indies. Also in South America, Europe, Asia, Africa, Australia, and New Zealand.

## 2. *Albugo sibirica* (Zalew.)

*Cystopus sibiricus* Zalew. Bot. Cent. 15 : 222. 1883.

No material of this species has been examined. It is known only from the original description, where it is recorded from some species of *Boraginaceae* from Siberia erroneously referred by Baron von Thümen to *Echinosperrum Lappula*. It is said to differ from *A. candida* in its smaller measurements and in the structure of the epispore of the oöspore.

## 3. *Albugo tropica* (Lagerh.) Lagerh. ined.

*Cystopus tropicus* Lagerh. ; Pat. & Lagerh. Bull. Soc. Myc. France 8 : 123. 1892.

This species was described from Ecuador on some unidentified species of *Piperaceae*. Material in the herbarium of the New York Botanical Garden from the type locality, and presumably a part of the original collection, is on *Peperomia pellucida* H.B.K., a species which is also widely distributed in the West Indies and Central America.

## 4. ALBUGO IPOMOEAE-PANDURANAE (Schwein.) Swing.

Jour. Myc. 7 : 112. 1891

*Aecidium Ipomoeae-panduranae* Schwein. Schr. Natur. Ges. Leipzig 1 : 69. 1822.

*Caecoma convolvulatum* Link, in Willd. Sp. Pl. 6<sup>2</sup> : 49. 1825.

*Uredo Convolvulae* Spreng. Syst. Veg. ed. 16. 4 : 572. 1827.

*Aecidium Ipomoeae* Schwein.; Berk. *Grevillea* 3: 60. 1874.  
(Hyponym.)

*Cystopus Convolvulacearum* Otth; Zalew. Bot. Cent. 15: 223.  
1883.

*Cystopus Convolvulacearum* Speg. Ann. Soc. Ci. Argent. 17: 128.  
1884.

*Cystopus Ipomoeae-panduranae* Stev. & Swing. Trans. Kan. Acad.  
Sci. 11: 67. 1889.

Sori amphigenous or caulicolous, white or light-yellow, prominent, superficial, 0.5–20 mm., rounded, often confluent and frequently producing marked distortions of the host; conidiophores hyaline, clavate, unequally curved at base, about  $15 \times 30 \mu$ ; conidia short-cylindric, similar or the terminal more rounded, hyaline; the membrane with an equatorial thickening, usually very pronounced,  $14\text{--}20 \times 12\text{--}18 \mu$ ; oösporic sori separate from the conidial, caulicolous, rarely on the petioles,  $1\text{--}2 \times 5\text{--}6$  cm. or even more, causing marked distortion of the host; oöspores light yellowish-brown,  $25\text{--}55 \mu$ ; epispore papillate or with irregular, more or less curved ridges.

The position in the genus of this species has varied quite a little in the various elaborations which have appeared in recent years. Berlese and De-Toni\* included it in *Cystopus Tragopogonis* from which it was separated by Saccardo.† According to Zalewski (l. c.) and Fischer‡ it is placed next to *A. candida*, in the first instance on account of the structure of the epispore of the oöspore, and in the second as the result of inaccurate observations as to the thickness of the conidial membrane. In his *Monografia delle Peronosporacee*, Berlese attempts to accommodate the species to this varied treatment and so places *C. Ipomoeae-panduranae* next to *C. candida* on account of its conidial membrane having no equatorial thickening, and includes *C. Convolvulacearum* Speg. among those species which have an equatorially thickened conidial membrane, and at the same time cites various species of *Convolvulaceae* as hosts of *C. Tragopogonis*. An examination of co-type material of Spegazzini's species leaves no doubt concerning its identity with the North American species. Three packets of the material distributed by Ellis and Everhart in their North

\* Saccardo, Syll. Fung. 7: 234. 1888.

† Syll. Fung. 9: 340. 1891.

‡ Rabenh. Krypt. Fl. ed. 2. 4<sup>1</sup>: 419. 1892.

American Fungi 1809 were examined. Berlese had previously \* cited this as authentic material of the thin-walled species, but it proved to be the most pronouncedly thick-walled specimen at hand. In a conidium of  $12\ \mu$  diameter the thickening frequently reaches  $5\ \mu$  making the connecting strand of protoplasm but  $2\ \mu$ .

The results of the morphological investigations of Stevens,† coupled with markings and general development of the epispore of the oöspore, lead to the conclusion that Zalewski was correct in his placing of the species. That the relationship of this species should long be in doubt is not surprising, as the oöspores which are borne in large galls on the stems of the host escaped notice until recently, while the conidia on the majority of hosts bear a superficial resemblance to those *A. Tragopogonis*. In all the material examined the conidia are short-cylindric, appearing in certain planes almost cubical, except in the case of those on *Ipomoea Batatas*, the sweet potato, which are very much more rounded than typically. It is not impossible that a distinct species occurs in this host.

ON CONVULVULACEAE:

*Calonyction aculeatum* (L.) House, Florida, Britton 419; Oaxaca, Holway 3735.

*Convolvulus incanus* Vahl, Texas, Heller 1910.

*Ipomoea Batatas* (L.) Lam., Alabama, Earle 2265; Delaware, Chester; Louisiana, Langlois (N. Am. Fungi 1809); Mississippi, Earle (Econ. Fungi 47); New Jersey, Arthur, Ellis (N. Am. Fungi 205), Stevens; South Carolina, Ravenel (Myc. Univ. 815), Rolfs 1685; Porto Rico, Underwood & Griggs 8.

*Ipomoea carolina* Pursh, Louisiana, Langlois 598; South Carolina, Rolfs.

*Ipomoea lacunosa* L., ? Kansas, Swingle; North Carolina, coll. ign.

*Ipomoea leptophylla* Torr., Kansas, \* Bartholomew (Fungi Columb. 2003).

*Ipomoea mexicana* A. Gray, New Mexico, Mulford 920; Mexico (city), Pringle 6607.

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\* Icon. Fung. Phyc. 7. 1898.

† Bot. Gaz. 38: 300-302. f. 1, 2. 1904.

*Ipomoea pandurata* L., Alabama, Carver; Delaware, Commons; Florida, Hume 79, Nash 1889, Tracy 7155; Georgia, Underwood; Illinois, Hart; Indiana, Arthur, Olive; Missouri, Kellerman, Galloway, Tracy & Galloway; New Jersey, \*Halsted 164 (Econ. Fungi 377, also conidia as 336), Stevens; Ontario, \*Dearness; Virginia, Paul (Fungi Columb. 2004).

*Ipomoea Pes-caprae* L., Bahamas, Hitchcock; Porto Rico, Heller 1396.

*Ipomoea simulans* Hanbury, Morelos, Pringle 6565.

*Ipomoea triloba* L., Arizona, LeRoy, Pringle.

*Pharbitis hederacea* (L.) Choisy, District of Columbia, Williams; Georgia, Underwood; Illinois, Seymour; Indiana, Olive, Underwood; Kansas, Bartholomew (Fungi Columb. 2002); Kentucky, Kellerman; Louisiana, Langlois 589; Missouri, Galloway, Pammel; Nebraska, Williams; New Jersey, Halsted (Econ. Fungi 334b, 334c) Stevens; South Carolina, Ravenel (Fungi Am. 501), Rolfs 1686; Virginia, Seymour (Econ. Fungi 334a).

*Pharbitis purpurea* (L.) Voigt, Georgia, Underwood; Mississippi, Tracy.

*Thyella tamnifolia* (L.) Raf., Cuba, Britton & Shafer 679.

The following additional hosts are reported within our limits:

*Convolvulus sepium* L., *Ipomoea incarnata* Vahl, *I. Jalapa* Michx., and *Quamoclit Quamoclit* (L.) Britton.

TYPE LOCALITY: North Carolina, on *Ipomoea* "pandurana" L.

DISTRIBUTION: Ontario to California, Central America and the West Indies. Also in South America, Europe, Asia and Africa.

##### 5. ALBUGO LEPIGONI (de Bary) Kuntze, Rev.

Gen. Pl. 2: 658. 1891

*Erysibe sphaerica*  $\beta$  *Caryophyllacearum* Wallr. Fl. Crypt. Germ. 2: 193. 1833.

*Cystopus Lepigoni* de Bary, in Rabenh. Fungi Europ. 483. 1863.

*Cystopus argentinus* Speg. Bol. Acad. Ci. Cordoba 11: 28. 1887.

Caulicolous or epiphyllous; sori rounded or elongate, 1-3 mm., yellowish; conidiophores clavate; conidia with the membrane of uniform thickness throughout, of two kinds, the terminal larger, hyaline or light-yellow, globular, 25-30  $\mu$ , the membrane about 5  $\mu$

thick, the lower smaller, hyaline, globose or ovoid,  $18-25 \times 18-23 \mu$ , membrane about  $1-2 \mu$  thick; oöspores produced in the leaves and stems of the host,  $50-65 \mu$ , light-brown, finely and densely papillate or echinulate, the tubercles showing a tendency to be confluent and form short ridges.

Infesting as it does only the maritime *Caryophyllaceae*, this species is of necessity restricted in its habitat, yet appears to be as widely distributed as its chief host, *Tissa marina*, from which it was originally described. Material has been examined from various European countries and from Algiers. Hennings\* also reports it from South America. What is presumably the same species is described as *Cystopus argentinus* by Spegazzini, who fails to give really distinguishing characters by which it can be separated from the present species. The morphology of the species has been studied by Ruhland.†

ON CARYOPHYLLACEAE:

*Tissa leucantha* (Robs.) Greene, California, *Parish* 4462.

*Tissa marina* (L.) Britton, California, *Parish*; New York, *Britton*.

TYPE LOCALITY: Germany, on *Arenaria marina* L. = *Tissa marina* (L.) Britton.

DISTRIBUTION: New York and California. Also in South America, Europe and Africa.

6. **Albugo Swertiae** (Berl. & Kom.)

*Cystopus Convolvulacearum* Speg. var. *Swertiae* Berl. & Kom.; Berl. Riv. Pat. Veg. 9: 26. 1900.

The only known locality for this species is the Amur region in eastern Siberia where it was collected on *Swertia connata* Schrenk by Komarof. An examination of this material shows the present species to be very closely related to *A. Tragopogonis*, yet quite distinct. Species of *Swertia* and the closely related genus *Frasera* have a wide distribution in North America.

7. **ALBUGO TRAGOPOGONIS** (DC.) S. F. Gray, Nat.

Arr. Brit. Pl. 1: 540. 1821.

*Uredo candida*  $\beta$  *Tragopogi* Pers. Syn. Meth. Fung. 233. 1801.

*Uredo Tragopogi* DC. Fl. France 2: 237. 1805.

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\* Hedwigia 35: 210. 1896.

† Hedwigia 41: 179. 1902.

- Cystopus spinulosus* de Bary, in Rabenh. Fungi Europ. 479. 1862.  
*Cystopus cubicus* de Bary, Ann. Sci. Nat. IV. 20: 132. 1863.  
*Cystopus pulverulentus* B. & C. Jour. Linn. Soc. Bot. 10: 357.  
1869.  
*Cystopus brasiliensis* Speg. Bol. Acad. Ci. Cordoba 11: 481. 1889.  
*Albugo spinulosa* Kuntze, Rev. Gen. Pl. 2: 658. 1891.  
*Cystopus Tragopogonis spinulosus* Davis, Trans. Wis. Acad. 11:  
165. 1897. (Hyponym.)  
*Cystopus Mikaniae* Speg. Ann. Mus. Nac. Buenos Aires III. 1:  
67. 1902.

Sori hypophyllous or caulicolous, prominent, deep-seated, white or yellowish, pulverulent, rounded or elongate,  $1-3 \times 1-8$  mm.; conidiophores hyaline, clavate, about  $12-15 \times 40-50 \mu$ ; conidia light-yellow or hyaline, short-cylindric, the terminal larger and less angular than the lower, membrane with an equatorial thickening,  $12-15 \times 18-22 \mu$ ; oöspores produced in the stems and leaves of the host, dark-brown or almost black at maturity, very opaque,  $44-68 \mu$ ; epispore reticulate, areolae  $2 \mu$ , wing bearing papillate tubercles at its angles.

The oöspores, which are produced in the leaves or rarely in the stems of the host, have been examined from a number of American and European specimens on hosts representing *Ambrosiaceae*, *Cichoriaceae* and various tribes of *Carduaceae*. The wing of the reticulation is lowest in specimens from the first families mentioned, while those on *Carduus* are scarcely more pronounced. The oöspores from various species of *Senecio* have the widest wing, while those from *Matricaria* are intermediate between those last mentioned. Oöspores produced on *Parthenium* have broader and lower reticulations than do the majority of specimens examined. It is however apparent that the American as well as the European material on the tribes *Cynareae*, *Senecioneae*, *Anthemideae* and *Heliantheae* belong to the same species. The only other North American hosts of this family for an *Albugo*, so far as is known, are of the tribe *Inuleae*. As no American material on these hosts contained oöspores, they were studied from European specimens and found to be identical with those produced on other members of *Carduaceae*. It appears from this that the American material from hosts of this tribe should be referred to the present species.

While there are minor differences in the conidia and in the rela-

tive size of the areolae of the oöspores, there do not appear to be sufficient grounds for the separation of the material examined into additional species. Especially is this true in regard to de Bary's *Cystopus spinulosus*, which is supposed to have pronounced spines on the oöspore. Dr. A. Fischer has examined the type specimen of this species and declares the character unreliable.\* This is borne out by the more recent investigations of Dr. Magnus.† Since then Berlese has figured the spinulose oöspores,‡ using the material distributed by von Thümen (Myc. Univ. 1423) on *Inula salicina* from Parma. The figures of the entire oöspores have a spinulose appearance due to the projection of the reticulations beyond the margin of the spore. The figure of an enlarged portion of the episporium looks very unlike anything found by me in the packet of this material, or, for that matter, in any other, as no such episporium has been observed by me in any specimen of the genus.

South American material from hosts of the tribes *Astereae* and *Eupatorieae* was examined. Oöspores similar to those produced on species of other tribes of this family were found on *Ageratum conyzoides* from Ecuador. From the same host Ule, in 1884, collected material in Brazil which has been referred to *Albugo brasiliensis* (Speg.) P. Hennings § and which was issued in Rabenhorst-Winter-Pazschke Fungi Europaei 3873 as *Cystopus Tragopogonis*. From a comparison of these two South American specimens it appears that Spegazzini's species is merely a synonym of *A. Tragopogonis*. Two other South American species, *Cystopus Mikaniae* Speg. and *Albugo Solivae* Schröt., have been described, but no material of either is at hand for examination. Inasmuch as the original descriptions of these species are scarcely distinctive and the hosts are closely related to species known to be hosts of *A. Tragopogonis*, it is very probable that they are also synonyms of that species. In addition to the above, another species, *Cystopus pulverulentus* B. & C., was described from an unidentified species of *Compositae* from Cuba. According to Dr. Farlow || the type "cannot be traced in Herb. Curtis by the number cited in the original

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\* Rabenh. Krypt. Fl. ed. 2. 1<sup>4</sup>: 422. 1892.

† Ber. Deutsch. Bot. Ges. 11: 327-330. pl. 15. 1893.

‡ Icon. Fung. Phyc. pl. 5. 1898.

§ Hedwigia 35: 212. 1896.

|| Bibl. Index N. Am. Fungi 1: 177. 1901.

description." As the latter is too vague to allow of a more definite determination than would the mere citation of the host, this species had probably best be placed with the present one. The morphology of this species has been studied by Stevens.\*

## ON AMBROSIACEAE:

*Ambrosia artemisiaefolia* L., Alabama, \*Carver 180; Illinois, \*Hart; Kansas, \*Swingle 1667; Massachusetts, \*Farlow (N. Am. Fungi 205b), \*Seymour; Missouri, \*Demetrio (N. Am. Fungi 2421); New Jersey, \*Halsted (Econ. Fungi 291a), Stevens; New York, Underwood; South Dakota, Chaney, Williams (Econ. Fungi 291b); Wisconsin, Pammel.

*Ambrosia psilostachya* DC., Iowa, \*Macbride; South Dakota, Rydberg 798; Utah, Macbride.

*Ambrosia trifida* L., Kansas, Swingle.

*Gaertneria acanthocarpa* (Hook.) Britton, Utah, \*Garrett (Fungi Columb. 2205).

*Iva ambrosiaefolia* A. Gray, Arizona, \*Griffiths (W. Am. Fungi 336, on "*Franseria tenuifolia* Gray"); New Mexico, Tracy 810.

*Iva ciliata* Willd., Illinois, \*Hart; Missouri, \*Hart.

## ON CARDUACEAE:

*Artemisia biennis* Willd., Montana, Anderson & Kelsey.

*Carduus arvensis* (L.) Robins., New York, Arthur, Brown, \*Halsted (Econ. Fungi 302), Stevens, Underwood; Ontario, Dearness.

*Carduus lanceolatus* L., Newfoundland, ? Waghorne.

*Carduus nuticus* (Michx.) Pers., Minnesota, Holway 241; Ontario, Dearness.

*Carduus spinosissimus* Walt., Louisiana, \*Langlois 335.

*Matricaria matricarioides* (Less.) Porter, California, \*Abrams 2487; Oregon, \*Lloyd.

*Parthenium integrifolium* L., Iowa, \*Arthur.

*Parthenium repens* Eggert, Kansas, Hitchcock 1086.

? *Senecio cymbalarioides* Nutt., Montana, Kelsey.

*Senecio Hartianus* Heller, Colorado, Rydberg & Vreeland 5499.

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\* Bot. Gaz. 32: 85, 97, 259. pl. 3; pl. 4, f. 43, 53. 1901.



*Senecio oblanceolatus* Rydb., Colorado, *Demetrio* (N. Am. Fungi 2208, on "*S. aureus*." The host is mixed but chiefly as cited here).

*Senecio peninsularis* Vasey & Rose, Baja California, \**Palmer* 659.

*Senecio serra* Hook., Montana, \**Kelsey*; Washington, \**Piper*.

ON CICHORIACEAE:

*Tragopogon porrifolius* L., Massachusetts, *Farlow* (N. Am. Fungi 2056); New Jersey, *Halsted* (Econ. Fungi 445); New Mexico, \**Mulford* 1285a; New York, *Arthur*, *Underwood*.

The following additional hosts are reported within our limits: *Antennaria plantaginifolia* (L.) Richards., *Artemisia canadensis* Michx., *Gaertneria discolor* (Nutt.) Kuntze, *Senecio aureus* L., *S. lugens* Richards., and *S. serra integrusculus* A. Gray.

TYPE LOCALITY: Europe, on *Tragopogon porrifolius* L.

DISTRIBUTION: Newfoundland to Washington, Baja California and Alabama. Also in South America, Europe, Asia, Africa and Australia.

8. *ALBUGO QUADRATA* (Kalchb. & Cooke) Kuntze, Rev.  
Gen. Pl. 2: 658. 1891

This species is known only from Cape Colony, where it was collected on *Herpestis verticillaris* Nees by McOwen. The conidia are most nearly like those of *A. Tragopogonis*, but in the absence of oöspores it is impossible satisfactorily to refer the species to a place in the genus.

9. *Albugo Tillaeae* (Lagerh.)

*Cystopus Tillaeae* Lagerh.; Pat. & Lagerh. Bull. Soc. Myc. France 8: 167. 1891.

No material of this species has been examined; but the description indicates a close relationship with *A. Bliti*. It is known only from Quito, Ecuador, the type locality, where it occurs on *Tillaea rubescens* H.B.K. Species of this genus occur sparingly in tropical America.

## 10. ALBUGO BLITI (Biv.) Kuntze, Rev. Gen. Pl.

2: 658. 1891

*Uredo Bliti* Biv. Stirp. Rar. Sicilia 3: 11. 1815.*Caecoma Amaranthi* Schwein. Trans. Am. Phil. Soc. II. 4: 292. 1832.*Cystopus Bliti* de Bary, Ann. Sci. Nat. IV. 20: 131. 1863.*Cystopus Amaranthi* Berk. Grevillea 3: 58. 1874.*Cystopus Amaranthacearum* Zalew. Bot. Cent. 15: 223. 1883.*Cystopus Cyathulae* Winter; Roum. Rev. Myc. 11: 66. 1889.

Sori amphigenous, white or very light-yellow, prominent, sub-superficial, rounded, sometimes confluent, 1–10 mm.; conidiophores hyaline, cylindric, about  $15 \times 60 \mu$ ; conidia hyaline, elliptic, the terminal smaller, globular; the membrane with an equatorial thickening,  $8-15 \times 15-20 \mu$ ; oöspores produced in the leaves of the host, dark-brown,  $50-60 \mu$ , averaging  $55 \mu$ ; epispore coarsely reticulate, areolae  $6-8 \mu$ .

According to Zalewski (*l. c.*) there are two species of *Albugo* on the genus *Amaranthus*, the first, *Cystopus Bliti*, being confined to *Amaranthus Blitum*, while the second, *C. Amaranthacearum*, infests the other species of the genus. The points of distinction are confined to the oöspore and are of questionable value, although their reliability could not be disproved on account of a lack of authentic European material. The oöspores of *C. Bliti* are said to be formed only on the stem of the host, to vary from light- to dark-brown in color and to have irregular reticulations. Those of *C. Amaranthacearum* are borne in the leaves of the host, are of a uniform dark-brown and are regularly reticulate. The only specimen at hand on undoubted *Amaranthus Blitum* contains a few detached leaves with conidia only. That the place of oöspore-production cannot be regarded as of taxonomic value is evident, as this varies with the host in *A. candida* and in the same host in *A. Portulacae*. The color of the oöspore depends entirely upon maturity and may show remarkable variation just as do those of the present species in all specimens examined. The pattern of the reticulations cannot be taken as a taxonomic character unless accompanied by other marked distinctions, as the pattern is practically the same, or at most a modification of the same basic pattern, in *A. Bliti*, *A. platensis*, and *A. Portulacae*. In all of these

species it is by no means uncommon to find that a number of contiguous areolae are only imperfectly separated from each other by simple or even branched reticulations which end blindly before reaching the opposite side of the areola, thus producing a more or less complex labyrinth of ridges in place of the regular pentagonal or hexagonal reticulations which are typical of this group of species. The morphology of this species has been studied by Stevens.\*

ON AMARANTHACEAE :

*Acnida tamariscina tuberculata* (Moq.) Uline & Bray, Iowa, \*Arthur.

*Amaranthus Bigelovii* Uline & Bray, Texas, Heller 1867.

*Amaranthus blitoides* S. Wats., California, Underwood ; Montana, Reynolds ; Washington, \*Suksdorf 182.

*Amaranthus emarginatus* Salzm., Guadeloupe, Duss 4067.

*Amaranthus graecizans* L., Montana, \*Anderson.

*Amaranthus hybridus* L., Alabama, Earle 2264 ; Florida, Hitchcock 293 ; Illinois, Hart, \*Waite ; Indiana, Underwood (Ind. Fl. 99), Wilson ; Iowa, \*Hitchcock ; Kansas, Norton 425 ; Missouri, Bush 316, \*Tracy & Galloway ; Nebraska, Williams ; New Jersey, \*Halsted (Econ. Fungi 352), \*Stevens ; New York, Peck (Roum. Fungi Sel. 4551), Shear (N. Y. Fungi 198), Underwood ; Wisconsin, \*Davis, Pammel.

*Amaranthus Palmeri* S. Wats., New Mexico, Metcalfe 719 ; Chihuahua, \*Pringle 1112 ; Jalisco, Palmer.

*Amaranthus retroflexus* L., Alabama, Earle ; Illinois, Burrill, Earle ; Indiana, \*Bolley, Olive ; Iowa, \*Arthur ; Massachusetts, \*Farlow (N. Am. Fungi 206), Seymour (Econ. Fungi 2546) ; New Jersey, \*Stevens ; New York, Halsted (Econ. Fungi 354a), Jelliffe, Peck (Myc. Univ. 619), Underwood 396 ; Ontario, Dearness (Fungi Columb. 46) ; South Dakota, \*Griffiths (W. Am. Fungi 33) ; Wisconsin, Pammel.

*Amaranthus spinosus* L., Illinois, \*Earle ; Indiana, Rose ; Louisiana, Ball 662 ; Texas, \*Long (Fungi Columb.

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\* Bot. Gaz. 28 : 149, 233. pl. 11-15. 1900.

1709), *Stanfield*; Virginia, *Heller 1023*; Mexico, *Berlandier*; Porto Rico, *Millsbaugh*.

*Amaranthus tristis* L., Grenada, *Broadway*; St. Croix, *Ricksecker 109*.

*Amaranthus viridis* L., Florida, \* *Hitchcock 298*, *Nash 2179*.

*Cladothrix lanuginosa* (Moq.) Nutt., Kansas, *Hitchcock 431*; New Mexico, *Wooton*; Mexico, *Berlandier*.

*Cyathula lappulacea* Moq., New York, *Peck* (Roum. Fungi Sel. 4863).

Also reported from within our limits on the following additional hosts: *Acnida cannabina* L., *A. tamariscina* (Nutt.) Willd., *Amaranthus crispus* (Lesp. & Thev.) Braun, and *A. hybridus paniculatus* (L.) Uline & Bray.

TYPE LOCALITY: Sicily, on *Amaranthus Blitum* L.

DISTRIBUTION: Vermont to Washington, Mexico, Florida and the West Indies. Also in South America, Europe, Asia and Africa.

## II. ALBUGO PLATENSIS (Speg.) Swing. Jour. Myc.

7: 113. 1892

*Cystopus platensis* Speg. Rev. Argent. Hist. Nat. 1: 32. 1891.

Hypophyllous, sori at first pallid, later surrounded by a purplish line, irregular in outline, 1–5 mm., scattered or gregarious, prominent; conidiophores cylindric, about  $40\text{--}45 \times 15 \mu$ ; conidia elliptic,  $20\text{--}22 \times 18\text{--}20 \mu$ , very light-yellow, the membrane with an equatorial thickening which is darker-colored in the smaller terminal conidium; oöspores borne in the leaves of the host, very opaque, very dark-brown, globular,  $55\text{--}85 \mu$ , averaging  $60 \mu$ , finely reticulate, areolae about  $4 \mu$ .

This species is very closely related to *A. Bliti*, from which it is, however, quite distinct. The conidia of *A. Bliti* are hyaline and white in mass while those of *A. platensis* are slightly colored, appearing light-yellow in mass while the apical conidium has a darkened equatorial band. The oöspores, which are produced in the leaves of the host in both species, are very similar and at first sight indistinguishable. Those of *A. platensis* are very dark-brown, so opaque that until treated with HCl they appear as black grains, and are finely reticulate, while those of *A. Bliti* are lighter in color, less opaque, slightly smaller in size and more coarsely reticulate, the areolae being from one third to one half larger.

## ON ALLIONIACEAE:

- Boerhaavia anisophylla* A. Gray, New Mexico, *Wootton* 462.  
 ? *Boerhaavia diffusa* L., McComb's Expedition, *Newberry*.  
*Boerhaavia erecta* L., Florida, *Swingle* 4139; Sonora, *Palmer*;  
 Jamaica, *Harris* 6853; St. Croix, *Ricksecker* 401.  
*Boerhaavia hirsuta* Willd., Texas, \* *Long* (Fungi Columb.  
 1605, on "*B. decumbens*"); Yucatan, *Gaumer* 309; Cuba,  
*Britton & Shafer* 1; Guadeloupe, *Duss* 2174; Porto Rico,  
*Goll* 536.  
*Boerhaavia paniculata* Rich., Culebra, *Britton & Wheeler* 2.  
*Boerhaavia spicata* Choisy, Arizona, *Griffiths* 2071; New  
 Mexican, *Wootton*.  
*Boerhaavia Xanti* S. Wats., Sonora, *Palmer*.  
*Wedelia incarnata* (L.) Kuntze, Arizona, *Rusby*; New Mexico,  
*Skehan* 102, *Wootton*; Texas, *Seler* 1901; Utah, *Goodding*  
 809; San Luis Potosi, *Schaffner* 562.

Reported from within our limits on the following additional  
 hosts: *Boerhaavia Sonorae* Rose and *B. viscosa* Lag. & Rodr.

TYPE LOCALITY: Buenos Aires, Argentina, on *Boerhaavia*  
*hirsuta* Willd.

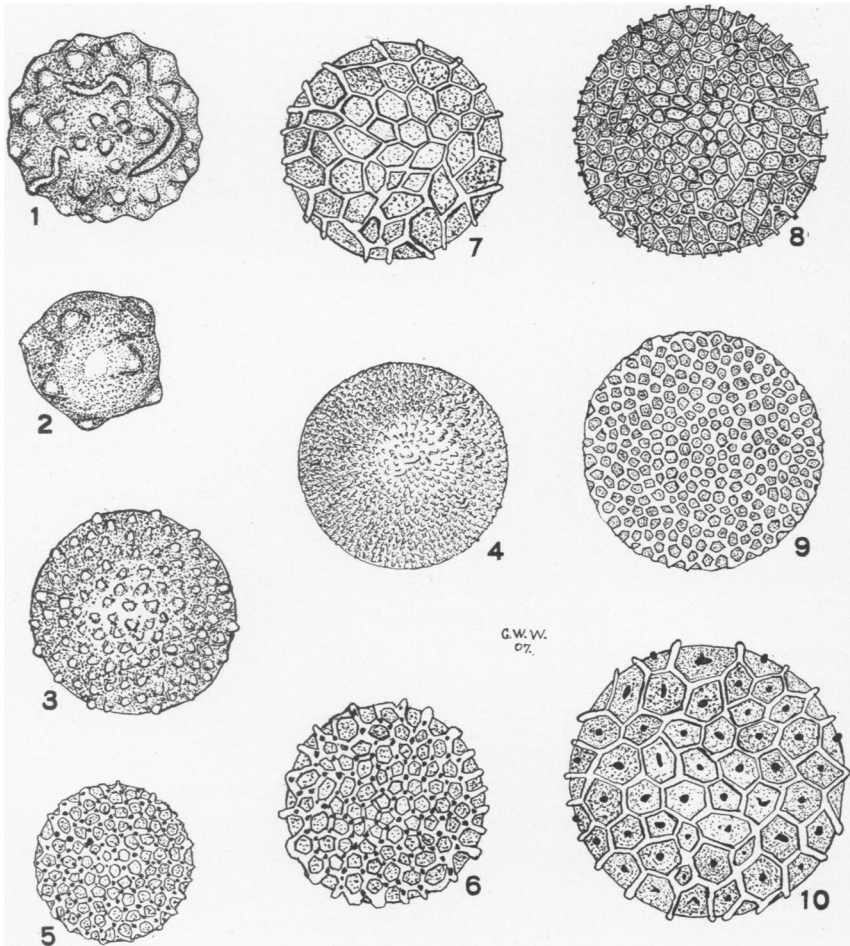
DISTRIBUTION: Utah to peninsular Florida, southern Mexico  
 and the West Indies. Also in South America, Asia and Africa.

12. *Albugo occidentalis* sp. nov.

Soris hypophyllis, subrotundis vel irregularibus, rarius confluentibus, superficialibus, prominentibus, subflavidis, 1–3 mm. crassis; conidiophoris cylindraceis, circa  $12 \times 40 \mu$ ; conidiis flavidis, breviter cylindraceis,  $14\text{--}20 \times 8\text{--}16 \mu$ , membrana hyalina, ad medium annulo cincta; oosporis in hospitis foliis, globosis, luteo-brunneis, regulariter tenuiterque reticulatis,  $50\text{--}60 \mu$  diametro, areolis pentagonis vel hexagonis, circa  $2 \mu$  crassis.

Sori hypophyllous, rounded or irregular in outline, sometimes confluent, superficial, prominent, yellowish, 1–3 mm.; conidiophores cylindric, about  $12 \times 40 \mu$ ; conidia discoid, the membrane hyaline with an equatorial thickening, contents yellow,  $14\text{--}20 \times 8\text{--}16 \mu$ ; oöspores borne in the leaves of the host with the conidia, globular,  $50\text{--}60 \mu$ , yellowish-brown, very closely and shallowly reticulate, areolae about  $2 \mu$ .

Type in herbarium of the New York Botanical Garden, *L. M. Underwood & A. D. Selby* 108, from the hills about Box Cañon,

Oöspores of *Albugo*. (All  $\times 500$ .)

1. *A. candida*, from *Raphanus sativus*, in Fungi Columbiani 1805.
2. *A. tropica*, from *Peperomia pellucida*, Ecuador, ex Herb. Lagerheim.
3. *A. Ipomoeae-panduranae*, from *Ipomoea pandurata*, in Economic Fungi 337.
4. *A. Lepigoni*, from *Lepigonum medium*, in Fungi Europaei 483.
5. *A. Swertiae*, from *Swertia connata*, in Fungi Rossiae Exsiccati 301.
6. *A. Tragopogonis*, from *Tragopogon porrifolius*, Mulford 1285a.
7. *A. Bliti*, from *Amaranthus hybridus*, in Economic Fungi 352.
8. *A. platensis*, from *Boerhaavia decumbens*, in Fungi Columbiani 1605.
9. *A. occidentalis*, from *Blitum capitatum*, type specimen, Underwood & Selby 108.
10. *A. Portulacae*, from *Portulaca oleracea*, in West American Fungi 31.

west of Ouray, Colorado, September 8, 1901, at an altitude of 2,300–2,500 m. On *Blitum capitatum* L.

ON CHENOPODIACEAE:

*Blitum capitatum* L., Colorado, \* *Underwood & Selby* 108.  
(Type.)

*Chenopodium rubrum* L., Montana, *Kelsey*.

This material was referred in the herbarium of the New York Botanical Garden to *A. Bliti*, but a superficial examination of the conidia was sufficient to throw doubt upon the correctness of the identification. The conidia differ in their yellow color and in their discoid form from those of *A. Bliti*, and from those of *A. platensis* in the brighter color and uniformly hyaline membrane, while in outline they approach most nearly to those of *A. tropica*. The oöspores, however, are markedly different from those of these species or of any other member of the genus. They are very closely reticulate, with the areolae so shallow as at first sight to give the appearance of pitting rather than reticulations. This is our rarest and most local species, yet none are more markedly distinct. It is represented in the material examined by only two collections, while but one American mycologist has referred to an *Albugo* which could belong to the present species. The inclusion by Berlese and DeToni\* of *Atriplex* among the hosts of *A. Bliti* appears to be the first mention of a species of this genus on a Chenopodiaceous host. No locality is given nor can the host be traced by any bibliographical assistance at hand. Later Pammel† reported the occurrence of *A. Bliti* upon the sugar beet in Iowa and mentions its occurrence on *Blitum*. He figures the conidia from *Beta* and the oöspores from *Amaranthus*, as they were not found on the former host. Later the same author‡ cites references to the occurrence of *A. Bliti* on *Chenopodium* in Europe, but no light has been gained from them.

DISTRIBUTION: Montana and Colorado. Probably also in Iowa and Europe.

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\* Sacc. Syll. Fung. 7: 236. 1888.

† Bull. Iowa Agr. Expr. Sta. 15: 236. pl. 6. 1891.

‡ Jour. Myc. 7: 102. 1892.

## 13. ALBUGO PORTULACAE (DC.) Kuntze, Rev. Gen.

Pl. 2: 658. 1891

*Uredo Portulacae* DC. Fl. France 5: 88. 1815.*Cystopus Portulacae* de Bary, Ann. Sci. Nat. IV. 20: 131. 1863.

Sori white or yellowish, on all parts of the host except the roots, rounded or irregular in outline, up to 5 mm.; conidiophores clavate, about  $9 \times 25 \mu$ , hyaline; conidia dissimilar, the terminal larger, cylindrical and papillate, the basal smaller, subglobular, about  $12-15 \times 15-22 \mu$ , walls hyaline, contents light-yellow; oöspores borne in the stems and leaves, globular, dark-brown, about  $70 \mu$ ; epispore regularly reticulated, with short ridges or papillate tubercles in the areas.

This species is restricted throughout its range to a single host, upon which it does not appear to be very common, although the distribution of both host and fungus is probably coextensive. It is easily distinguished from related species by the uniform thickness of the conidial membrane and by the tubercles in the areolae of the oöspore. The morphology of this species has been studied by Stevens.\*

## ON PORTULACACEAE:

*Portulaca oleracea* L., Connecticut, *Underwood*; Georgia, \**Underwood*; Illinois, *Blount*, *Burrill*, \**Earle*, *Waite*; Indiana, *Bolley*, *Olive*, \**Underwood*; Iowa, \**Arthur*; Missouri, *Galloway*; New Jersey, *Ellis* (N. Am. Fungi 1808), *Halsted* (Econ. Fungi 264a); New York, *Underwood*; New Mexico, \**Cockerell*; Ohio, *Tyler* (Ohio Fungi 83); Ontario, *Dearness* (Fungi Columb. 45, Econ. Fungi 264b); South Carolina, *Ravenel* (Fungi Am. 500); South Dakota, \**Chaney*, \**Griffiths* (W. Am. Fungi 31).

TYPE LOCALITY: France, on *Portulaca oleracea* L.

DISTRIBUTION: Vermont to South Dakota, New Mexico and Georgia. Also in South America, Europe, Asia and Africa.

## SPECIES EXCLUDENDAE

While several names have been proposed under this genus which for one reason or another cannot be retained, it appears scarcely necessary to mention any of these which have not gained admission to Saccardo's *Sylloge Fungorum*.

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\* Bot. Gaz. 32: 79, 97, 254. pl. 1; pl. 4, f. 44-46, 48-50. 1901.



*Cystopus Euphorbiae* Cooke & Massee, Grevillea **20**: 106. 1892.

The roughened conidia bespeak a closer relationship with the Uredinales than with the present genus.

*Cystopus Salsolae* and *C. Schlechteri* P. Sydow, Hedwigia Beibl. **38**: 142. 1889.

Authentic material of both these species has been examined. In both instances the host is covered with white spots which closely simulate the sori of *Albugo* and answer to the description in the diagnoses of these species. A microscopic examination of these spots failed to show anything except crystals of some chemical. These answer fairly well to the measurements given, but show no membrane or other parts as described, for the spores. Nothing more similar to conidia, however, was observed. The spores described as oöspores are present in fair abundance in the material of both species. They are borne apparently singly, at the apex of isolated conidiophores, and are the conidia of some species of Hyphomycetes and rather closely related to *Coniosporium* or *Torula*.

NEW YORK BOTANICAL GARDEN.